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THE REMOVAL OF

NECROTIC AND CARIOUS BONE

WITH HYDROCHLORIC ACID AND PEPSIN.*

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Sometimes it is desirable to remove dead bone without subjecting a weak patient to a dangerous or deforming operation. Attempts have been made with some success at clearing out this bone by a process of decalcification, but there are two chief reasons why failures have resulted as a rule. In the first place, it was discovered that superficial layers of dead bone were decalcified easily enough, but the acids did not reach deeply through the mass, especially if portions were infiltrated with caseous or fatty *débris*. In the second place, cellulitis was pretty apt to develop during the course of treatment. After much experimentation I have finally adopted a method of work which seems to be complete. An opening is made through soft parts by the most direct route to the seat of dead bone, and if sinuses are present they are all led into the one large sinus if possible. The large direct sinus is kept open with antiseptic gauze and the wound allowed to remain quiet until granulations have formed.

Granulation tissue contains no lymphatics, and absorption of septic materials through it is so slow that we have a very good protection against cellulitis. The next step consists in injecting into the sinus a two or three per cent. solution of hydrochloric acid in distilled water. If the patient is confined to bed, the injections can be made at intervals of two hours during the day; but if it is best to keep the patient up and about, the acid solution is thrown into the sinus only at bed-time. In either case the patient is to assume a position favorable for the retention of the fluid. Decalcification takes place rapidly in exposed layers of dead bone, and then comes the necessity for another and very important step in the process. At intervals of about two days an acidulated pepsin solution is thrown into the sinus (I use distilled water, f ℥iv ; hydrochloric acid, m xvj; Fairchild's pepsin, ℥ ss.), and this will digest out decalcified bone and caseous or fatty *débris* in about two hours, leaving clean dead bone exposed for a repetition of the procedure. The treatment is continued until the sinus closes from the bottom, showing that the dead bone is all out.

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Even in distinctly tuberculous cases the sinuses will close if apparatus for immobilizing diseased parts and tonic constitutional treatment are employed, as they should be in conjunction with our efforts at removing the dead bone.

If suppuration is free in any cavity in which we are at work, it is well to make a routine practice of washing out the cavity with peroxide of hydrogen before each injection.

It is a popular impression in the profession that living bone is not attacked by dilute mineral acids, but, as it makes a good deal of difference whether the impression is correct or not, I experimented as follows: A portion of the keratinoid layer was removed from the carapace of a turtle (*Nanemys guttatus*), and the animal was then placed tail downward in a glass of five per cent. hydrochloric acid solution. In the same glass I placed also a segment snipped from the plastron of the turtle, and a transverse section of an old dried humerus of a man. The piece of humerus was completely decalcified in six hours, the segment from the plastron was soft in about twenty hours, and the carapace of living bone was decalcified at the exposed part in thirty hours. I was then curious to know what effect the acid had had upon the blood-vessels of the decalcified bone, and Dr. Smith, of the laboratory of the Post-Graduate Medical School, made for me several sections of the carapace which included both decalcified and healthy bone. Investigation showed that all the blood-vessels were destroyed wherever the bone was softened, and the action of the acid had extended farther up along the larger blood-vessels than elsewhere. In the accompanying photomicrographs* the dark portions represent decalcified bone stained with carmin, and in the lighter portions the structure of the normal bone cells is readily distinguished. In Fig. 2* can be seen the line of extension of decalcification along three blood-vessels.

The difference in time between decalcification of the dead bone (six hours) and of living bone (thirty hours) is significant, a five per cent. solution of hydrochloric acid having been used.

If we use a two or three per cent. solution of hydrochloric acid, a wall of lymph and of granulation tissue is thrown out upon the surface of living bone for protection, and only dead bone is attacked. This at least has been my observation in several cases in which the results of treatment could be easily watched.

The details of treatment in some of the cases would be very interesting, but if the paper were lengthened to accommodate them my main points would be apt to hide.

* For cuts see *New York Medical Journal*, March 19th, 1892.



